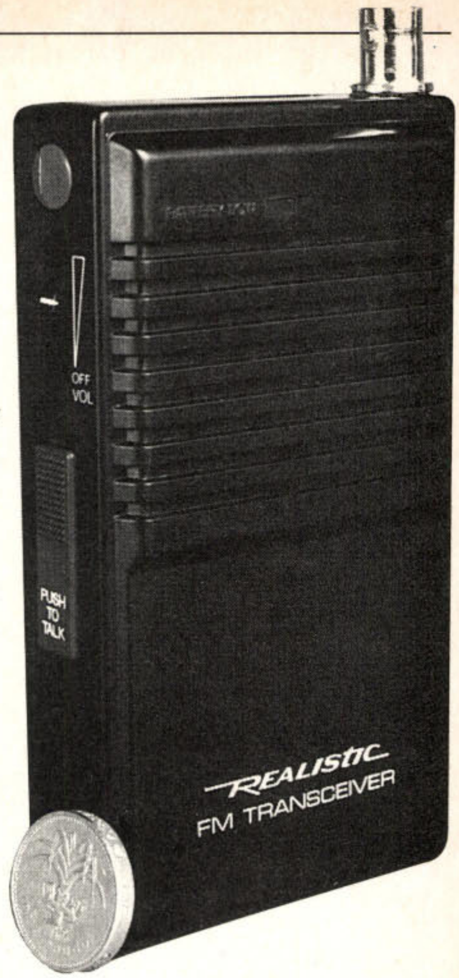
HANDY *from* TANDY - A 49 to 50MHz Transceiver Modification



Peter Julian G7PRO describes how you can modify an inexpensive Tandy 49MHz f.m. transceiver for use on the 50MHz amateur radio band.

A short while ago the regulations regarding the 50MHz band were relaxed. Restrictions were eased to allow not only the use of vertical antennas, but also mobile operation.

However, small portable 50MHz sets are not readily available. Fortunately, the reasonably priced 49MHz licence exempt 'walkie-talkies' seem to be ideal for conversion to 50MHz.

The licence exempt MPT1336 type approved devices fall into two main groups. They include 'toys' which have cheap a.m. super-regenerative receivers, and the more serious f.m. units having superhet receivers.

The latter group contains such devices as baby alarms, radio microphones and walkie-talkies. There are a number of different 49MHz hand-held sets produced by manufacturers such as Tandy, Maxon and Jesan.

Suitable For Conversion

A quick review of the available units will show which transceivers are the most suitable for conversion. First of all, let's take a brief look at the MPT1336 specification.

Any class of emission may be used with MPT1336, but the maximum effective radiated power (e.r.p.) is restricted to 10mW. Antennas must also be an integral part of the unit, with no provision for an external antenna.

Ancillary inputs may be used but cable lengths must not exceed 1.5 metres in length. Unlike the Citizen Band, there are no mandatory channels and the permitted range of operating frequencies are 49.82 to 49.98MHz.

However, due to American FCC regulations for the 49MHz band (all units appear to be imported and originally designed for the US market), 15kHz channel spacing seems to have been generally adopted by default.

The MPT1336 'walkie-talkies' are either single channel, three channel or five channel. All f.m. units have dual conversion receivers.

The single and three channel units are crystal controlled. Recrystalling these is relatively simple but the five channel sets are synthesised using a dedicated synthesiser (as with CB) and unfortunately do not lend themselves to conversion.

Baby alarms seem to be either single or two channel while radio microphones can have anything from one to three channels. The transmitters for these are designed for continual operation and are of course separate from the receivers.

The baby alarm receivers, although f.m. are only single conversion and not very sensitive. This may explain why, although manufacturers usually quote a 100 metre range, they can often be received up to at least half a mile away! Radio microphone receivers are generally dual conversion.

Simplest To Convert

For our purposes, the simplest radio to convert is the Tandy 'Realistic' TRC-501 single channel transceiver. This is the model I'm featuring, although the more expensive Jesan three channel unit is also well worth considering.

The modifications are in four sections **1:** Change frequency by replacing the crystals and retuning the receiver front end and transmitter stages. **2:** Increase transmitter output. **3:** Improve receiver selectivity and sensitivity by replacing the 10.7MHz ceramic filter with a two pole crystal filter. **4:** Add circuitry to allow connection of a 50Ω antenna.

Tandy supply a schematic diagram at the back of the TRC-501 owner's manual. This is very helpful when making modifications, but it's so small that most people will need a magnifying glass to read it. Unfortunately, this information has been discontinued for the later TRC-505.

The Crystals

To replace the crystals, the circuit board will have to be removed from the case. To do this, the belt clip must be removed from the back, revealing a cross-headed screw.

After removing the screw, gently prise off the back. The circuit board is held in place by one more cross head screw at the top of the board, see **Fig. 1** and **2,**

Take care not to break the wires connecting the electret microphone and the speaker as the board is lifted out. The transmit and receive crystals can now be unsoldered.

You'll notice that the transmit crystal leads are long, allowing the can to lay on top of other components. When replacing this crystal a small holder of the type used in radio control receivers will have to be wired in to allow the same flexibility.

As the original crystals are wire ended, two

pin holes have to be drilled larger, to accommodate the new receive crystal. I attempted to use two cage jacks but these held the crystal too high up, so the crystal either should be soldered directly onto the p.c.b. or some means of gripping the pins must be soldered beneath the p.c.b.

I dismantled an old crystal holder, discarded the plastics support and soldered the small clips directly onto the underside of the board. A spot of Araldite epoxy resin adhesive helped to give added support to prevent them tearing loose when changing crystals.

Bandplan Allocated

The bandplan for 50MHz has 51.41 - 51.83MHz allocated for the f.m. simplex channels at 20kHz spacing. The f.m. calling channel is 51.51MHz.

When choosing which channel to use, it's probably best to avoid 51.53MHz which is used by GB2RS news and also for slow Morse transmissions. Both crystals are fundamental, series resonance.

The frequency to which each crystal is cut is as follows:- receive crystal is RX frequency -10.7MHz and the transmit crystal is f/3.

Once the 50MHz crystals have been installed, the receiver front end needs to be retuned (see the photograph in **Fig. 1**.) There's only one transformer (L2) to peak with a plastics trimming tool. A metal screwdriver should **not** be used, apart from upsetting the tuning, there's serious danger of breaking the iron dust core.

To tune up the transmitter, a field strength meter and a digital frequency meter will be required. And using the frequency meter, check L7, which needs to be adjusted to the exact frequency.

Note: Remember that the oscillator will be operating at **one third** of the transmit frequency and any frequency measurement at the oscillator will give a reading in the 17MHz range. Then Adjust L6 in the frequency tripler stage for maximum output and then do the same with L5 and finally L1.

For convenience, a flexible antenna, as used on portable telephones, can be clipped onto the telescopic whip. However, if a longer telescopic antenna is fitted, L1 will need to be readjusted for maximum output.

Increase Power

The next stage is to increase transmitter power. With the original antenna, the effective radiated power (e.r.p.) is still 100mW or -20dBW. With a longer antenna this will of course be higher.

To increase actual transmitter output power, replace R81 (220Ω) with a wire link, replace C79 (33pF) with a 200pF disc capacitor and finally remove C77 (0.0047μF) and R85 (56Ω) and connect the emitter of transistor Q9 directly to ground (i.e. shorting out C77 and R85).

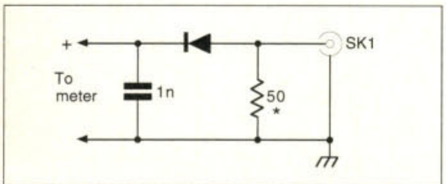


Fig. 3: Simple circuit for measuring r.f. output from modified 50MHz QRP transceiver (see text).

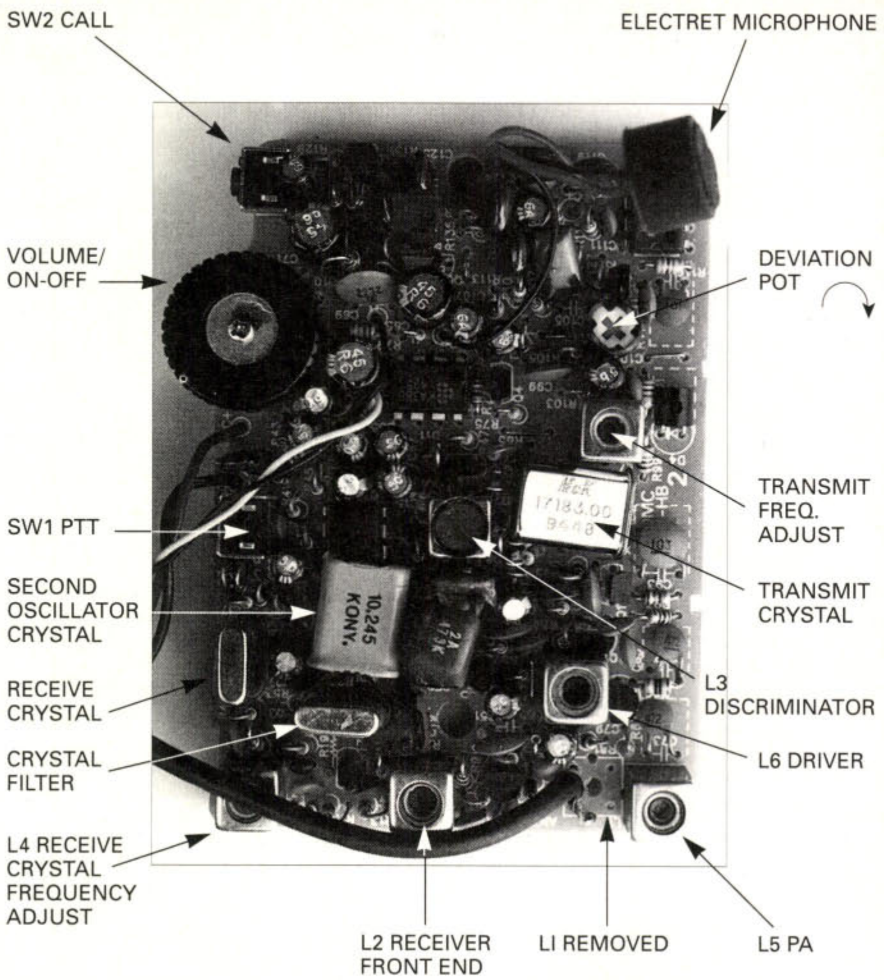


Fig. 1: The main transceiver p.c.b. removed from its case. (See text for details on the 49 to 50MHz conversion process). Annotations show major components involved in modifications. The coaxial cable (see G4SLU's text) connected in place of L1, is the antenna input/output.

Crystal Filter

The next job is to fit a crystal filter (see **Fig. 1** for location). This is required because a10.7 first i.f. ceramic type which is fitted as standard, not only has a wide bandwidth but also has an appropriate 6dB insertion loss.

A 10MO7AC two-pole crystal filter on the other hand has a much narrower bandwidth and the insertion loss is only 1.5dB. This modification is therefore quite an attractive proposition.

However, the crystal filter is physically larger than the original ceramic one and so a little extra space has to be found. To help, C27, a 2.2μF should be replaced with another capacitor which has longer leads. This is so it can be positioned on top of adjacent components thus providing the needed space.

A piece of insulation tape should also be placed between the crystal filter and the legs of the MC3357 i.f. chip (IC1). This is to prevent a short circuit.

Although the impedances of the two filters are different (ceramic = 470Ω/crystal = 1k8Ω), I didn't think it seemed necessary to change any components in order to match the crystal filter into the circuit. In fact, R19 can be by-passed if desired or even changed for a 1000pF capacitor.

The modification will alter the white noise level which is used to trigger the squelch and so the squelch is liable to stay open. However, changing R21 (33kΩ) to a value of 39kΩ should overcome any problem.

The receiver mixer is a bipolar transistor and there's only one tuned r.f. stage. Because of this the receiver is unlikely to perform well under strong signal conditions if the transceiver is connected to a high gain antenna.

Some operators may intend to boost transmitter output using a power amplifier. If so, it may be necessary to include further filtering to reduce harmonics, but I haven't checked this out.

External Antenna

For amateur radio use it's possible to connect an external antenna. I made a Pi-network to match the transceiver to 50Ω. ***Editorial note: See G4SLU's comments.***

A simple circuit which will be a help when tuning the 50Ω output stage is shown in **Fig. 3**. A BNC chassis socket can also be fitted into the case.

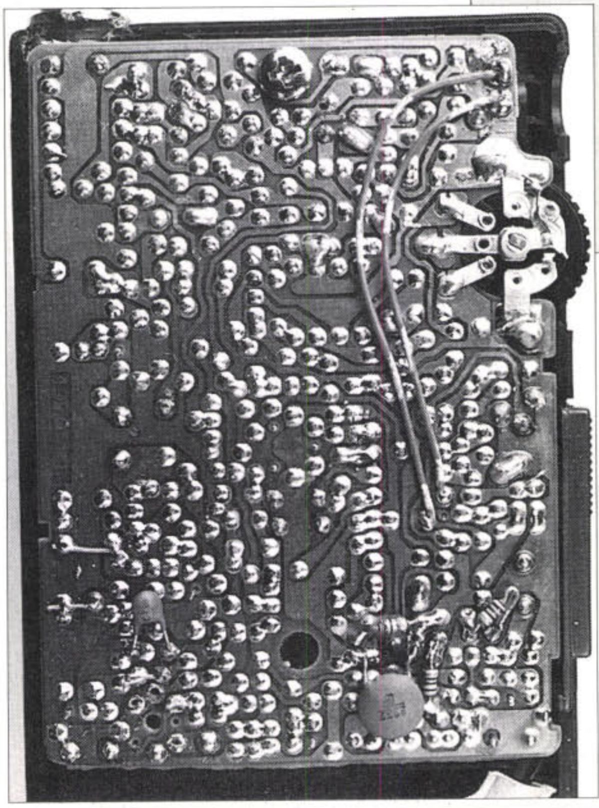
I enlarged the hole where the telescopic antenna went through the case with a hot soldering iron! This opens up the possibility of experimenting with different antenna.

Personally, I would recommend trying the magnetic loop for 50MHz as described by G6VNT in the 1991 February issue of *PW*. Another possibility for portable use is the telescopic antenna for hand-held scanners and walkie-talkies sold by Tandy, catalogue number 20-006.

The instructions with the 20-006 antenna state that, when used for transmitting, it can only be used as a $\lambda/4$ from 130 through to 535MHz. It also states that the loading coil must always be shortened by collapsing the section located just above it, but for our purposes the loading coil **must** be left in the circuit.

The instructions with the antenna concerning v.h.f. low band adjustment should be ignored. With the lower section collapsed and the top section extended to approximately 250mm from the top of the loading coil, the antenna will tune to 50MHz.

Fig. 2: Underside of p.c.b. when removed from case (take care with electret microphone connections). The two wires are G4SLU's modifications to provide 'squelch defeat' in place of 'call' button (see text). The screw, top centre, holds the p.c.b. in the case.



Clive Hardy G4SLU tried out the conversion procedure suggested by G7PRO and here's what he thinks:

Take note! You should be aware that any modification to the sets will invalidate the guarantee. Changing the transceiver's performance when operating on their original frequency is also illegal, as it takes them outside the MPT1336 regulation. **Editorial note: *We approached the Radiocommunications Agency on this point, and they have written to us in reply raising no objections to any of our readers holding an amateur radio licence, modifying, converting and using the transceivers on the 50MHz amateur band.* G3XFD.**

I used wire ended crystals. They were obtained from McKnight to the specification shown here: TX crystal 17.183MHz (series resonant), holder style J. RX crystal 40.850MHz (30pF), holder style J.

The transmit crystal is mounted above other components. It's advisable to secure it with adhesive. Make sure the metal case of the transmit crystal doesn't touch any leads around transistor Q13.

There are very slight differences between the boards currently used in the sets and those converted by Peter. This only really affects the 10.7MHz filter if it's to be replaced. On the latest Tandy boards there isn't quite enough room to fit a crystal filter in the space vacated by the ceramic filter. Fortunately, the space can be found by fitting R23, R53, R19, and C17 under the board.

I only fitted one of the radios with a crystal filter, but could not really detect much difference in sensitivity between the modified unit and the transceiver with the original ceramic filter. By-passing R19 ahead of the filter had no discernible effect on sensitivity either.

I converted the **Call** button to a squelch defeat. The conversion is done by cutting the tracks to the **Call** button and fitting wires from the contacts to either side of R21. Squelch defeat is useful when trying to copy weak signals that keep dropping below the threshold level, and also as a confidence function to check the radio is still operating.

The workshop manual supplied by Tandy, shows that the transmitter output is at 50Ω. This means that if a 50Ω output is required it can be taken directly from the secondary of L5. Simply remove L1 and connect the coaxial cable as in **Fig. 1**. (Inner cable to hole farthest from p.c.b. edge, screening 'outer' to hole nearest p.c.b. edge).

Whilst on the subject of antennas, I found that there isn't really the room inside the case for the fixing nut of a BNC socket. So I fixed the socket in place with Araldite epoxy resin adhesive. **Sandpiper Communications,Unit 5 Enterprise House, Cwmbach Industrial Estate, Aberdare, Mid Glamorgan CF44 0AE. Tel: (01685) 870425)**, make a 50MHz 'rubber duck' type of antenna which is suitable.

Next, I tackled the power and tuning up stages. And, to this end using all the modifications suggested by Peter to increase the output power the transmitter, produced about 30mW into 50Ω. For a real power increase I shorted out R81, the 220Ω resistor in the collector of the p.a. transistor. This produced a power output of at least 50mW. I then turned the f.m. deviation pre-set potentiometer fully clockwise for maximum deviation.

From the trials I carried out with the help of Phil G3XBZ, I would put the minimum range in town at 300 to 400 metres (between transceivers, using set top antennas). I think these little transceivers are ideal for very local communications, particularly in the open. **Finally, I'm very grateful to Ahmed Parekh, Technical Buyer of Tandy UK, at Tandy Centre, Leamore Lane, Bloxwich, Walsall, West Midlands WS2 7PS, for his help on this project. The TRC-501 transceiver for modification is available at Tandy shops priced at £24.95.**

G4SLU

Compact Transceiver

The TRC-501 is a compact transceiver, so it's not really feasible to make further alterations. It would be useful to fit extra channels, a manual squelch and power sockets, etc., but to do this it would be necessary to remove the board and fit it into a larger case.

Fitting the transceiver into a larger case would, of course, make possible the fitting of a small transmit p.a. as well as receiver front end improvements. Nevertheless, as it stands, a small, single channel transceiver should find many uses.

The transceiver may be useful for Novices for QRP 'cross town' QSOs. They could also perhaps be an alternative to 144MHz for rally control.

Finally, I must express my thanks to Jonathan G4RLM who helped me run some on-air tests with the converted sets. I hope you enjoy converting and using your 'Handy from Tandy' on 50MHz as much as I did.

PW

Crystals: The crystals were obtained from: McKnight Fordahl Ltd., Hardley Industrial Estate, Hythe, Southampton SO4 6ZY (contact Anne Rees for Amateur Radio specification crystals). Tel: (01703) 848961.